

# Toward An Improved Method for the Study of Speech Using Gated MRI

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## Rationale: Why Study Speech?

- ✧ **Speech problems are common:**
  - ✧ Over 14 million Americans have a speech or language problem
  - ✧ More than 79,000 speech pathologists
- ✧ **Groups most affected:**
  - ✧ Stroke victims (mostly elderly)
  - ✧ Children



# Rationale: Cleft Lip and Palate affects 1/700



Lip Repair





# The Palate's Role in Speech



Palate Repair



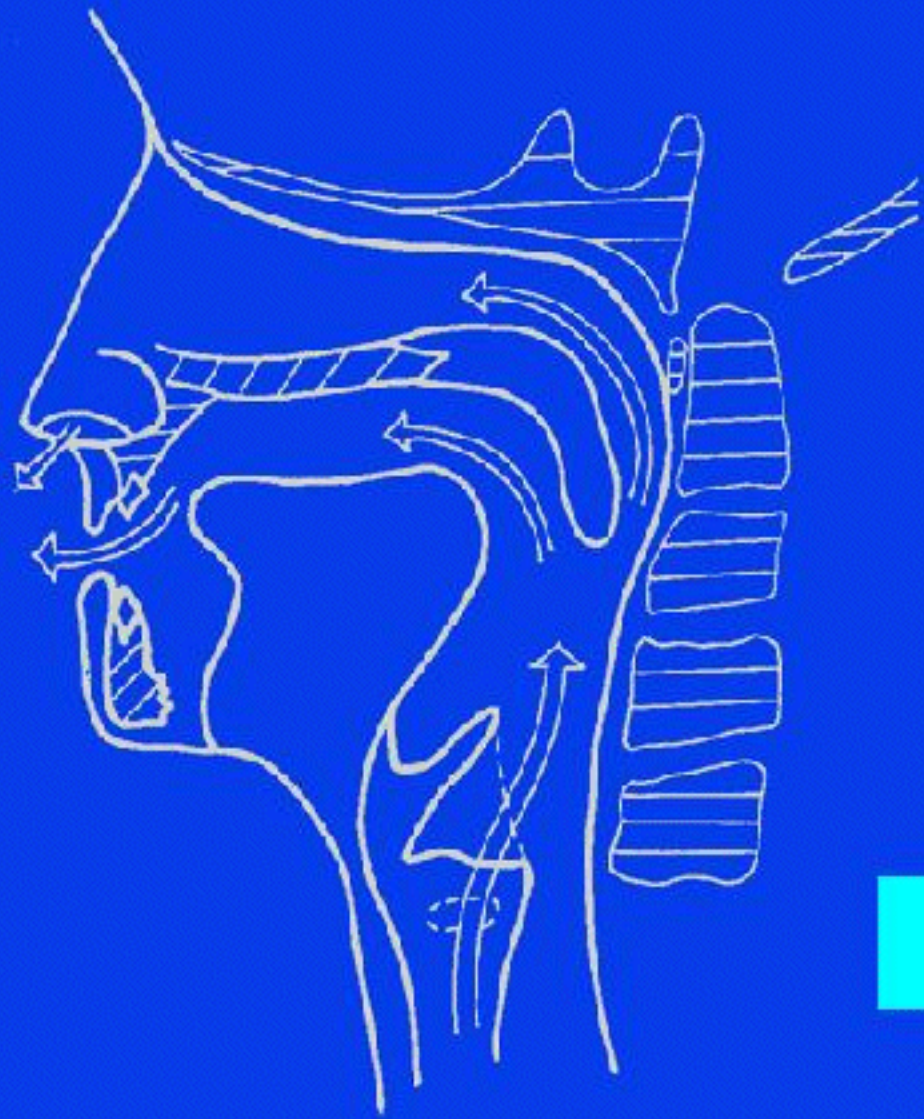


## Muscles of Palate Deranged with Clefts





## Soft Palate Valve Mechanism



Quiet Breathing

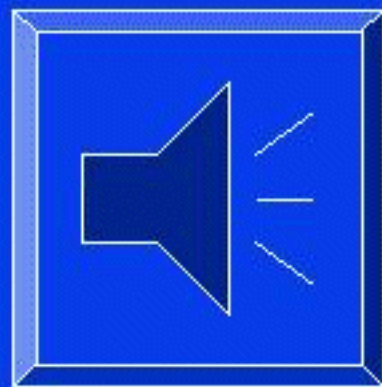


Valve Closes  
When Speaking

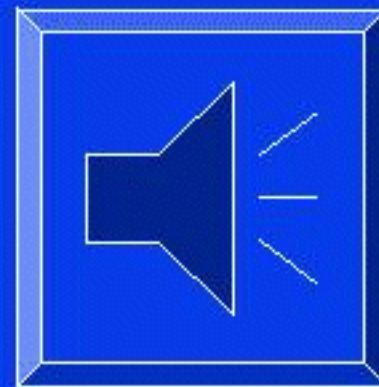


# Speech Pattern with Poor Closure

“Go Go Power Rangers, Mighty  
Morphin’ Power Rangers”



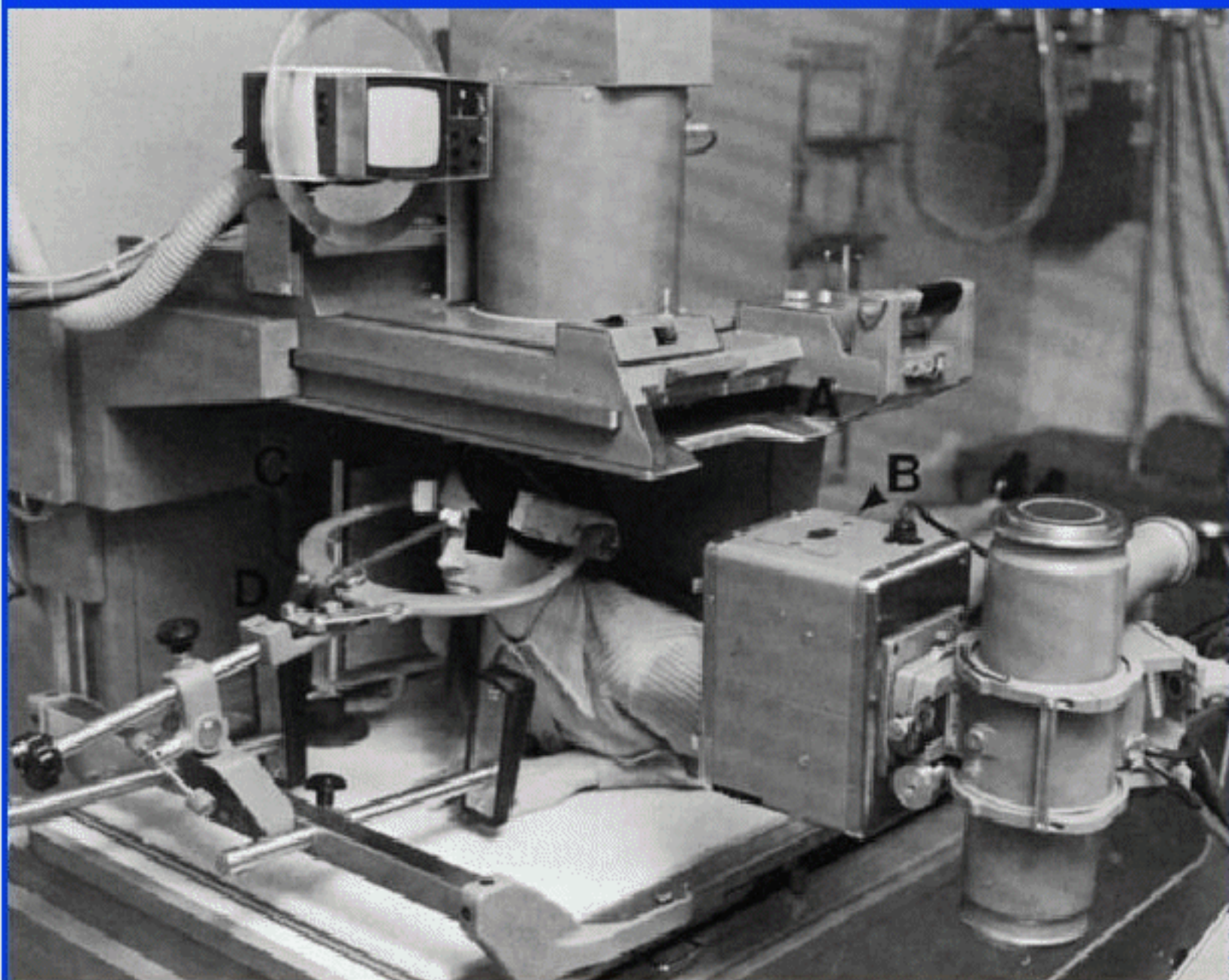
Pre-Repair



Post-Repair



# Speech Videofluoroscopy



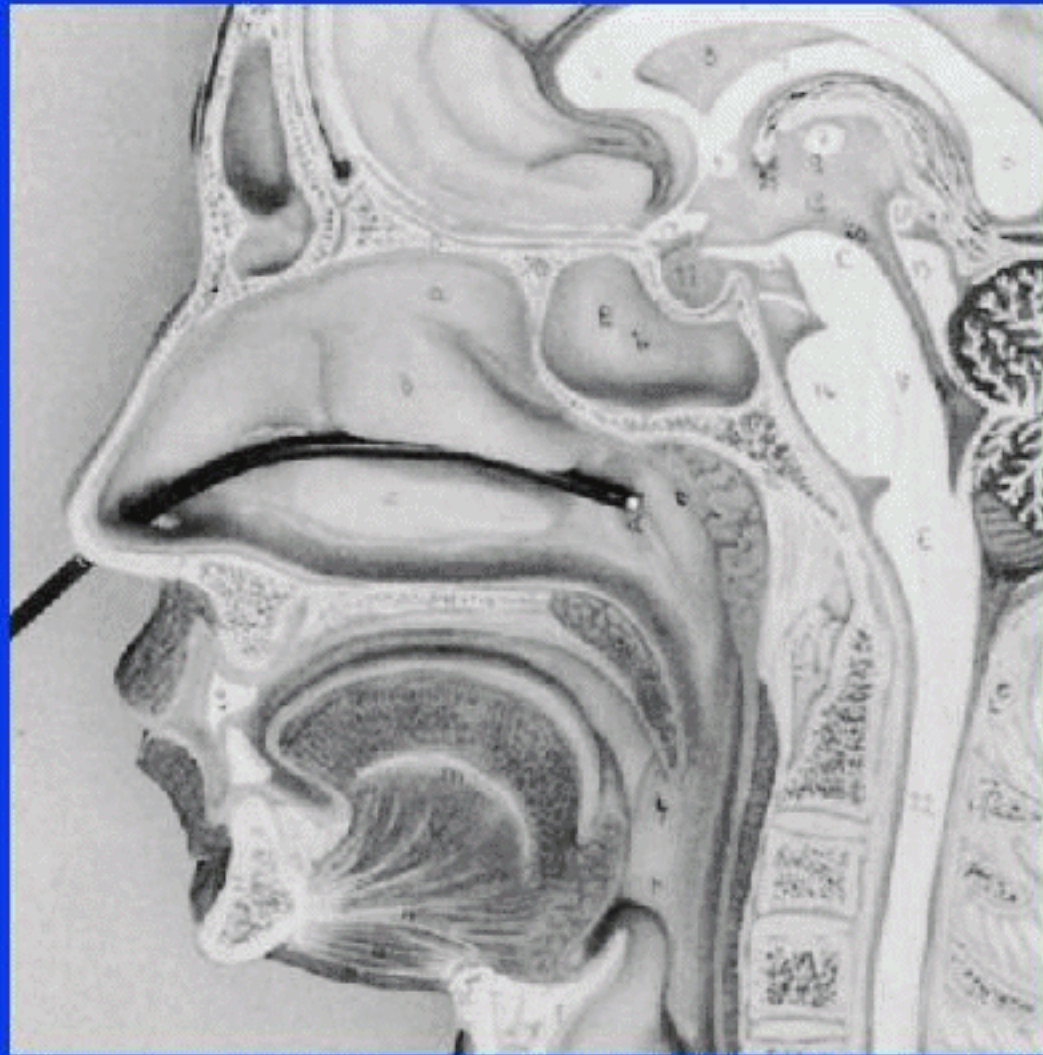
✧ Radiation Exposure

✧ 2D image

✧ Unwieldy



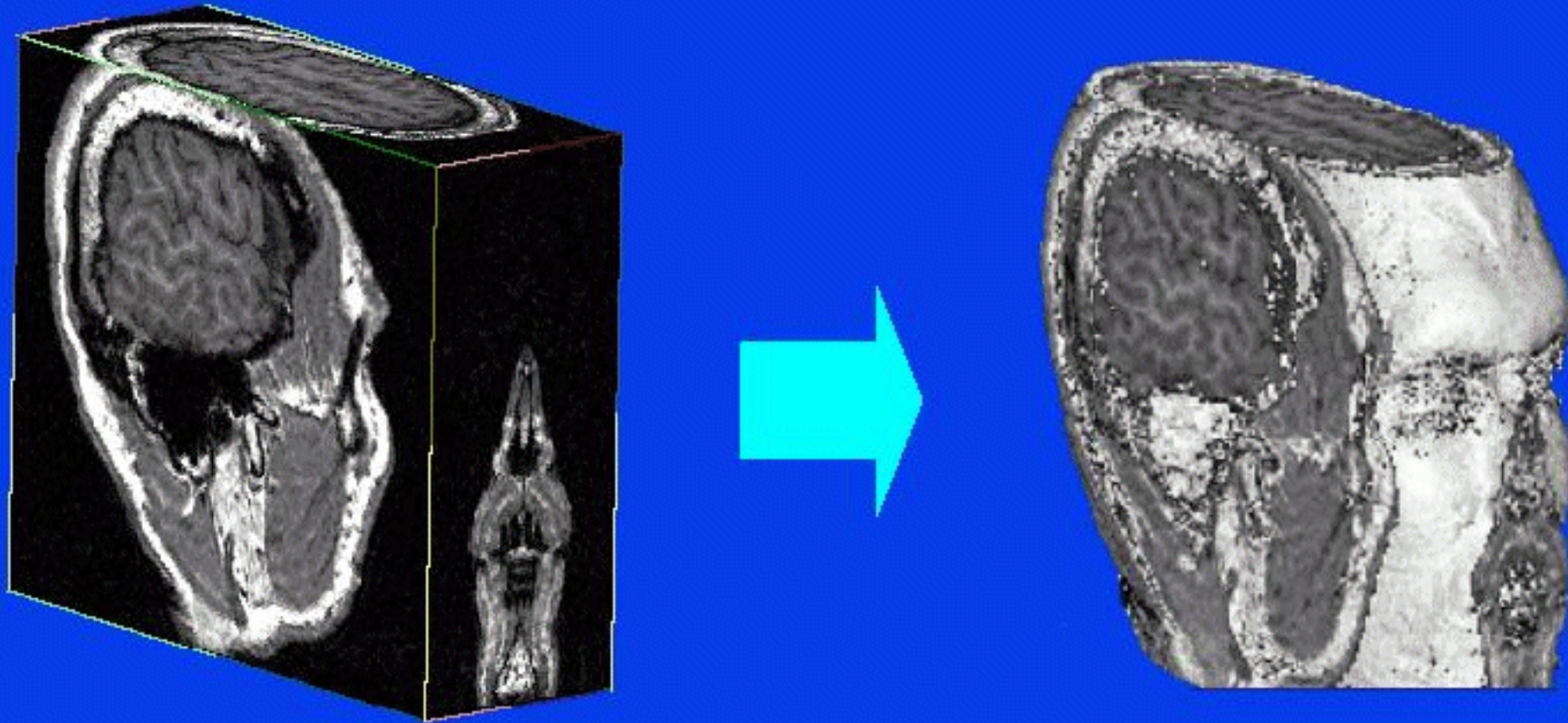
# Video-Nasendoscopy



- ✧ Instrument alters speech
- ✧ Only get “fly through” image



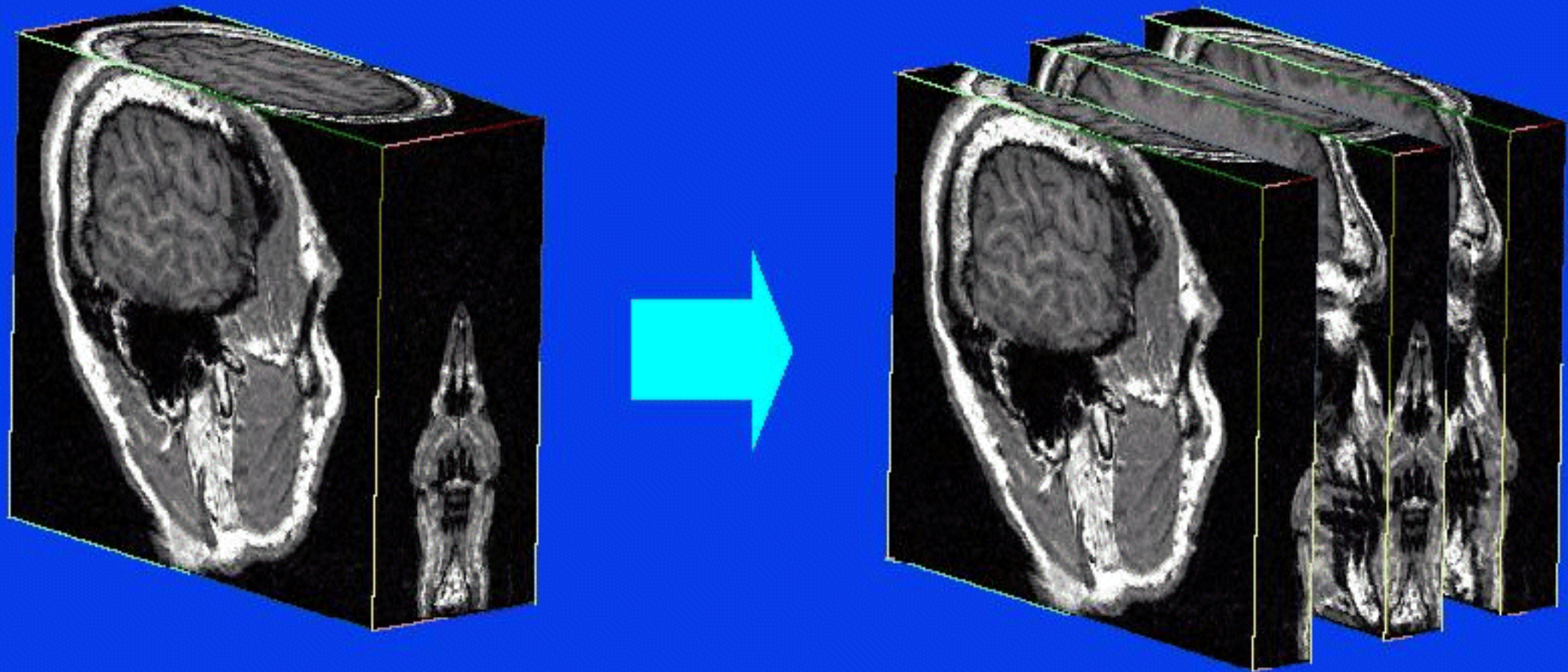
## Methods: MRI Captures a “Block” of Tissue



- ✧ Produces 3D data
  - ✧ No ionizing radiation
  - ✧ Good images of soft tissues



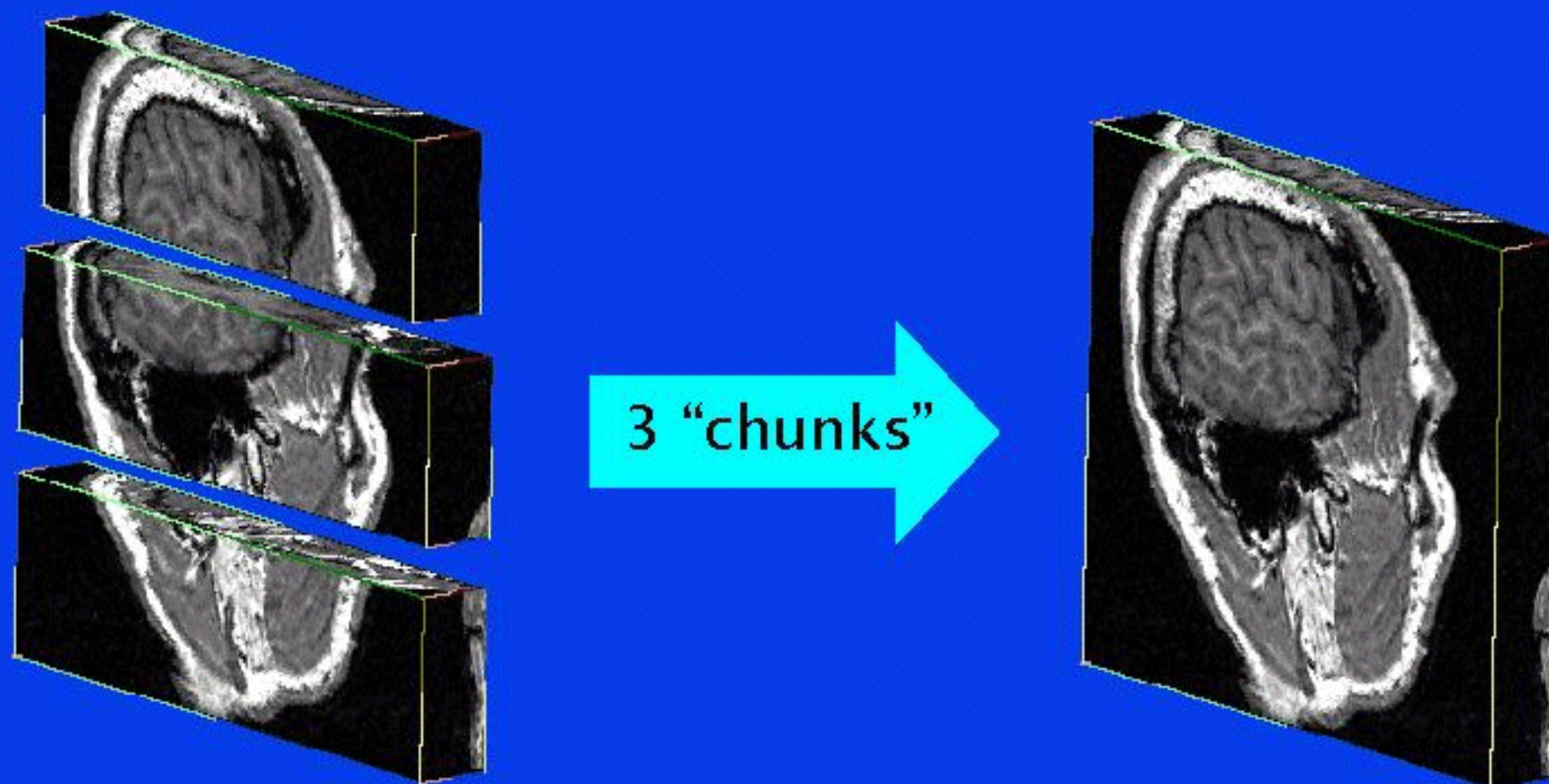
# Methods



Block is built as a series of slices.

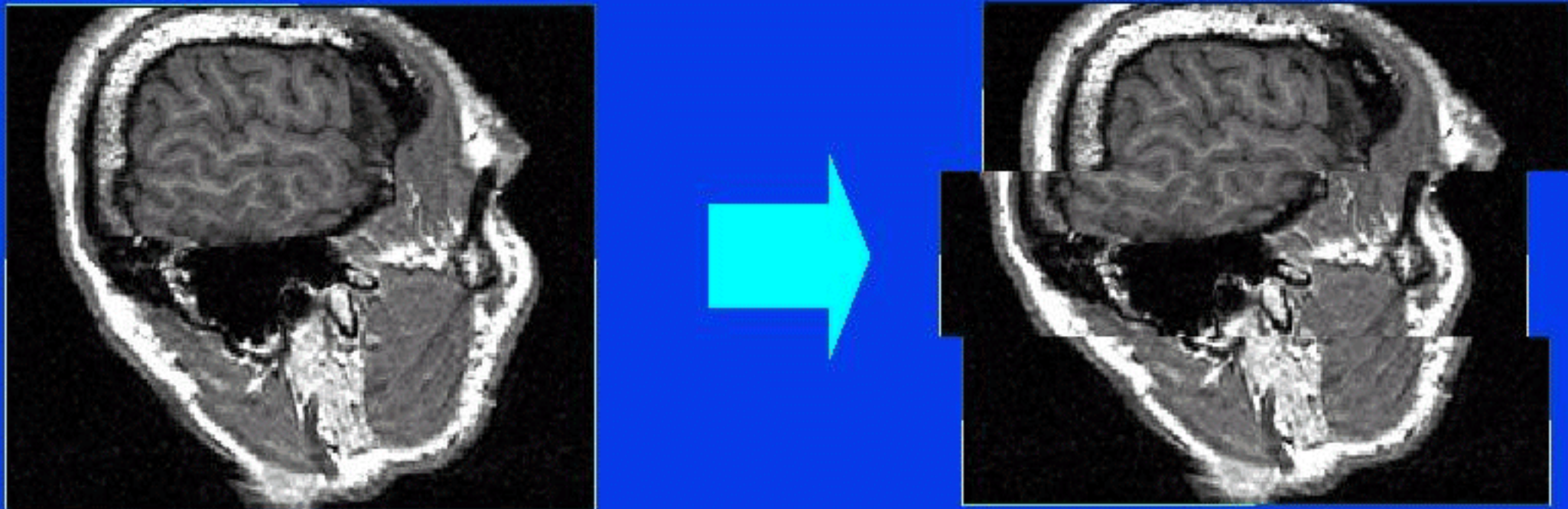


# Methods: Slice Building





## Methods

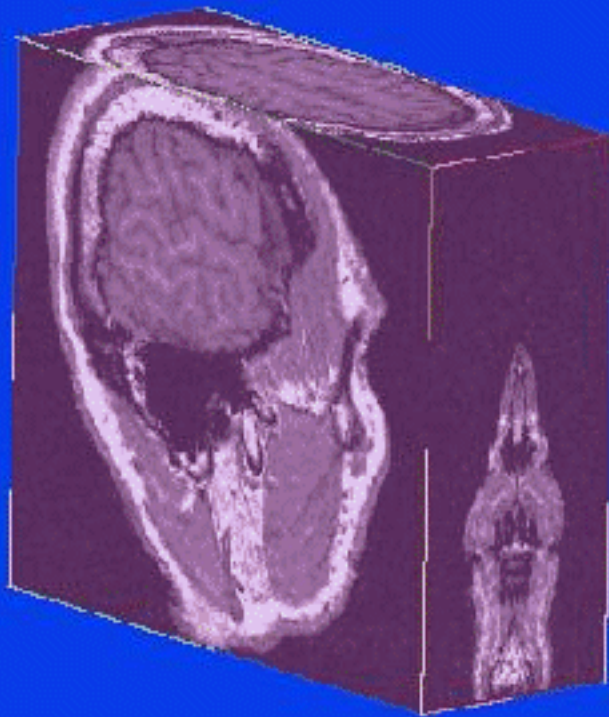


Motion during acquisition of slice causes image inaccuracy.

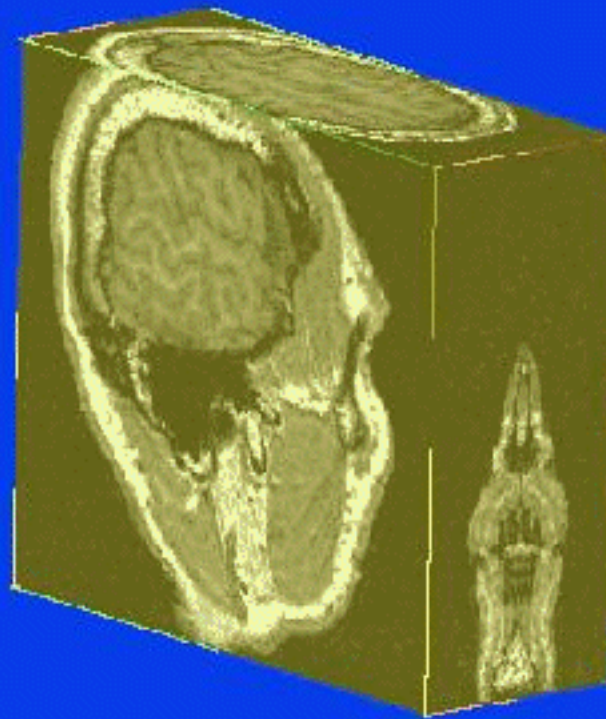


# Methods

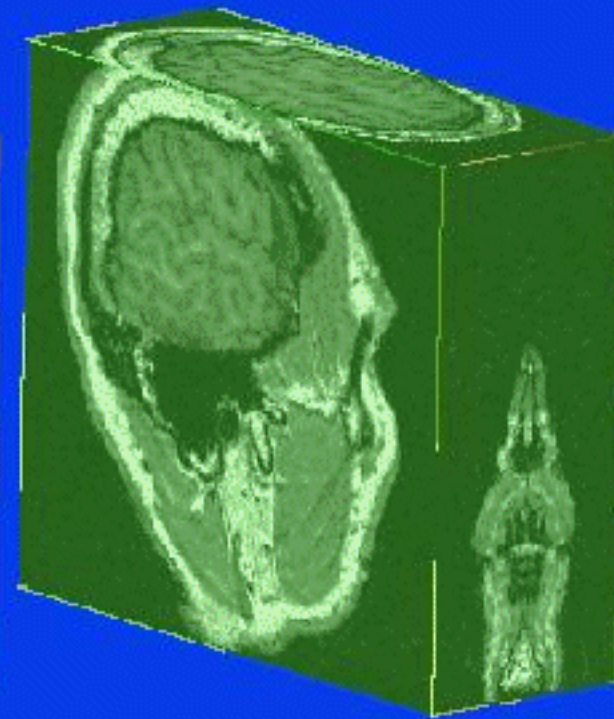
Time<sub>1</sub>



Time<sub>2</sub>



Time<sub>3</sub>



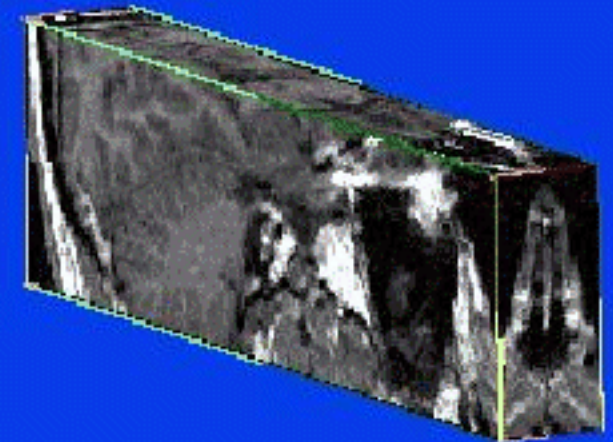


# Methods: Gating Speech



Trigger MRI  
with Speech

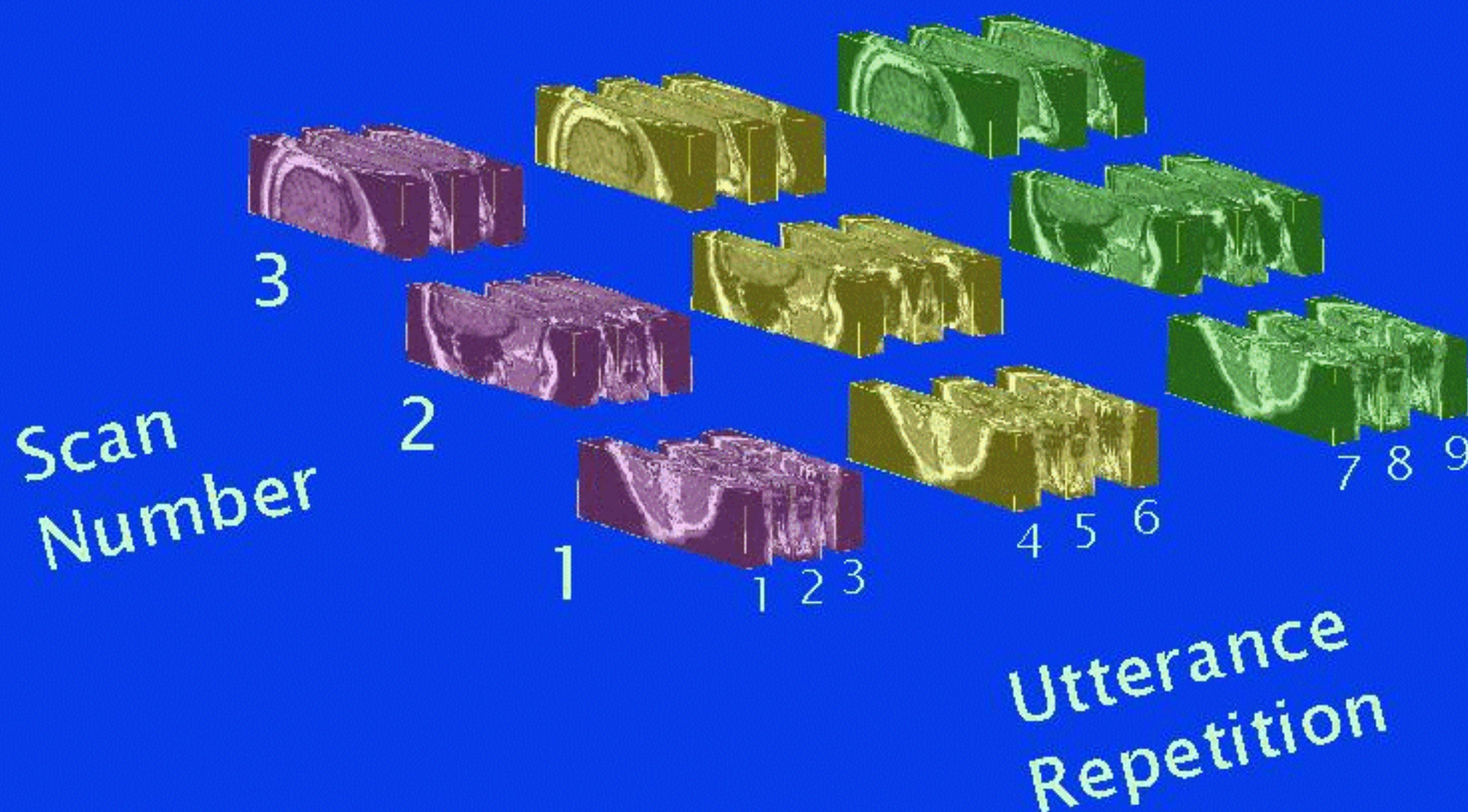
Acquire "Chunk"  
After  
Appropriate  
Delay



Repeat Until all  
"Chunks"  
Obtained

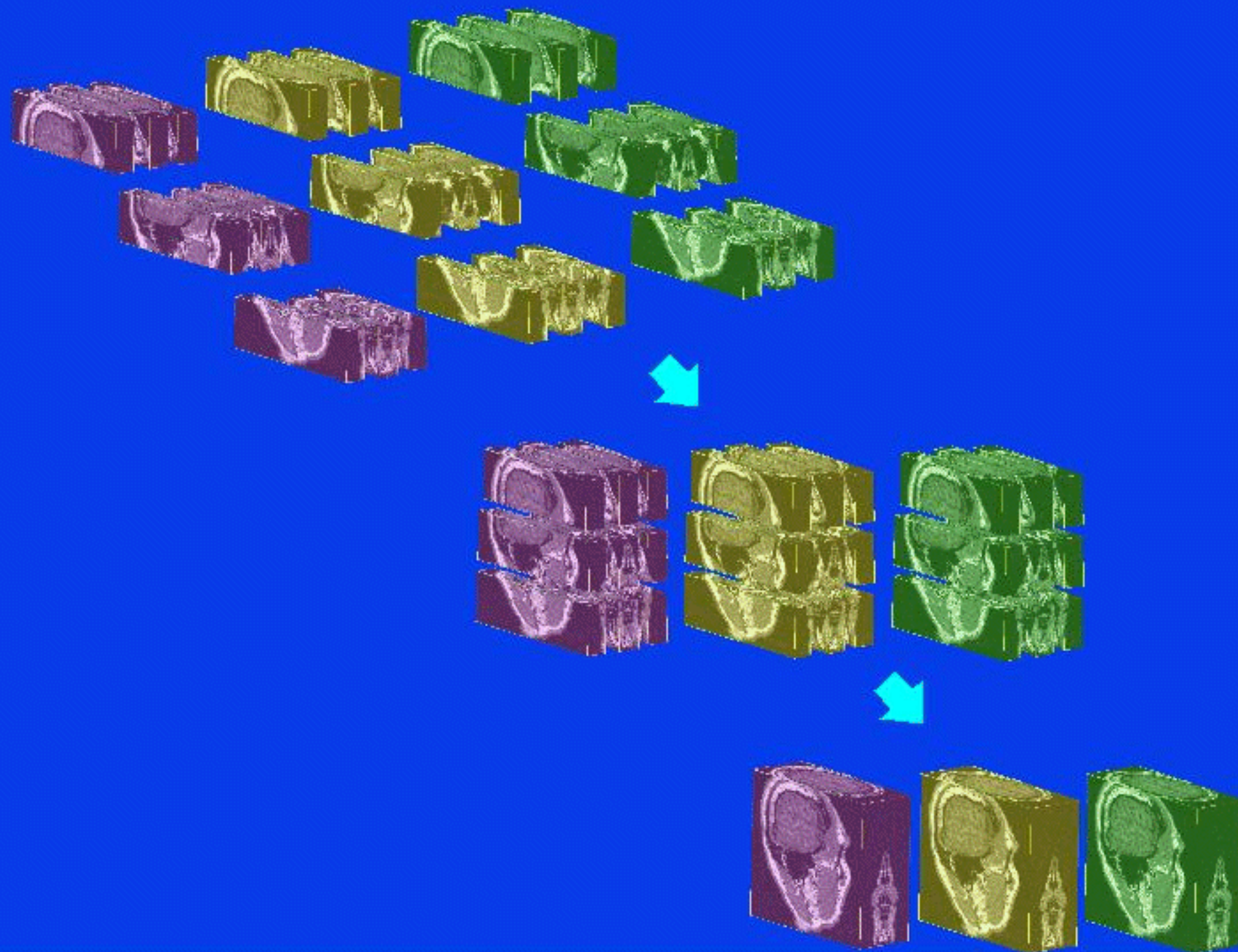


# Assembling Sequence Using Gating





# Methods: Reassemble Volumes





# Early Results



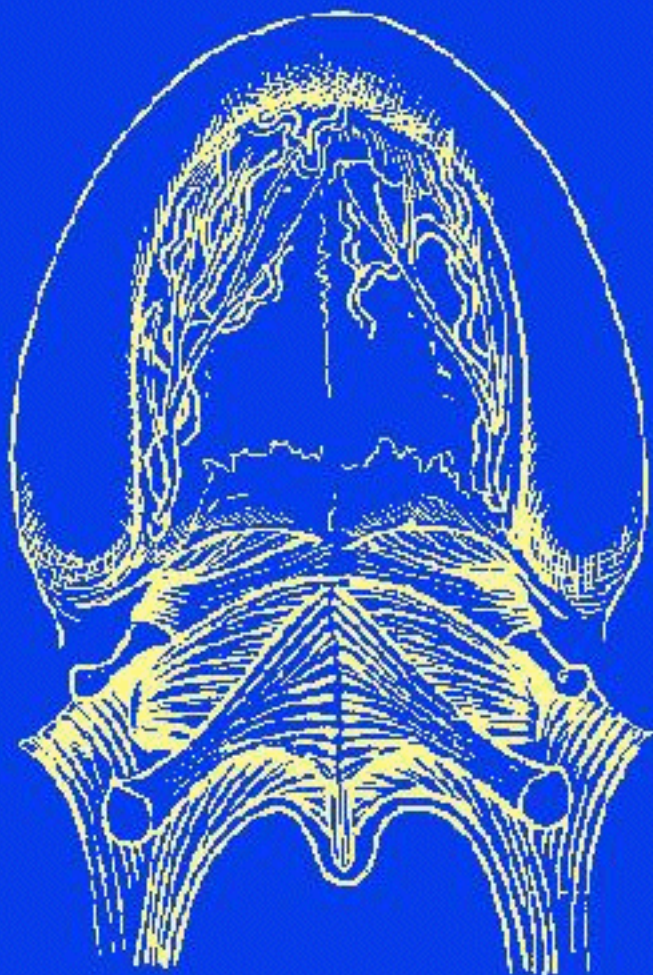


## Summary and Challenges

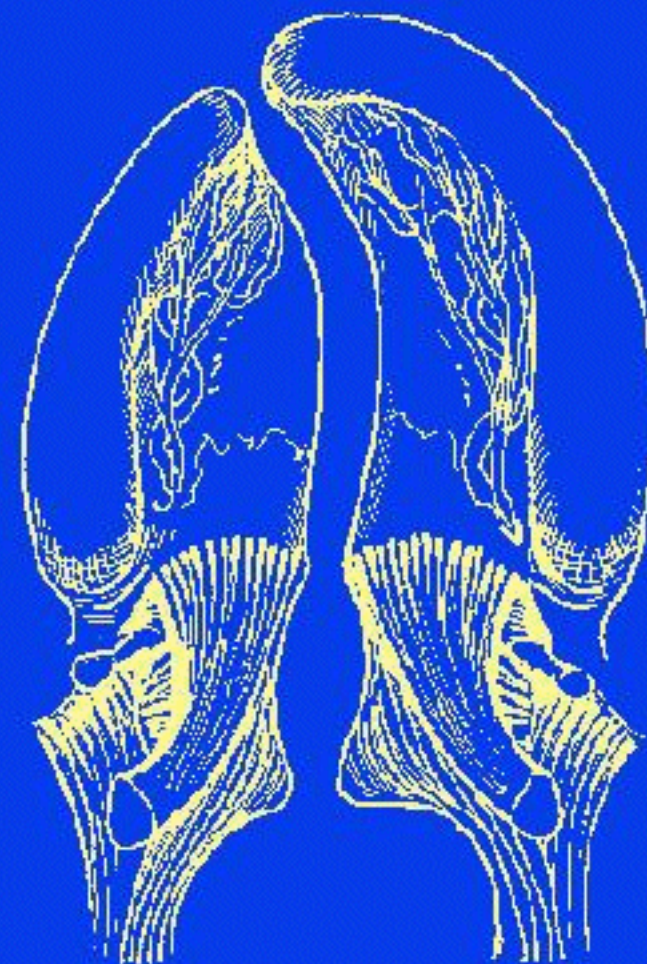
- ✧ Develop voice-sensing gate mechanism in the noisy MRI environment
- ✧ Increase resolution, both temporally and spatially



# Muscles of Palate Deranged with Clefts



Normal



Cleft



## Rationale: Why Study Speech?

- ✧ Speech problems are common:

- ✧ Over 14 million Americans have a speech or language problem
- ✧ More than 79,000 speech pathologists treat them

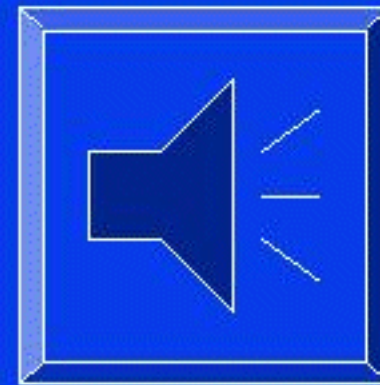
- ✧ Speech problems commonly affect:

- ✧ Stroke victims (mostly elderly)
- ✧ Children

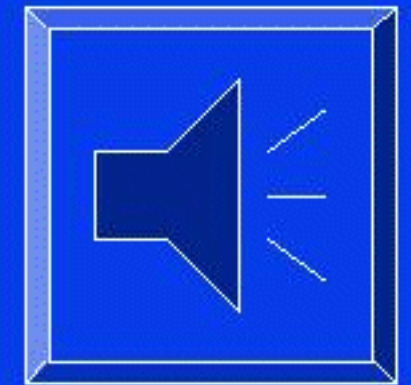


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“Go Go Power Rangers, Mighty Morphin’ Power Rangers”

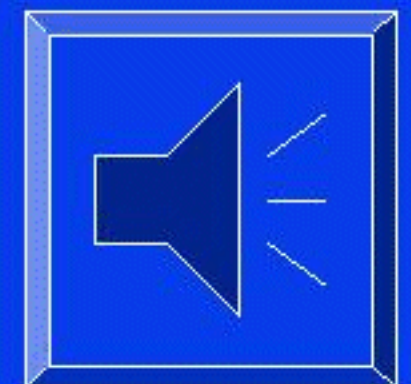
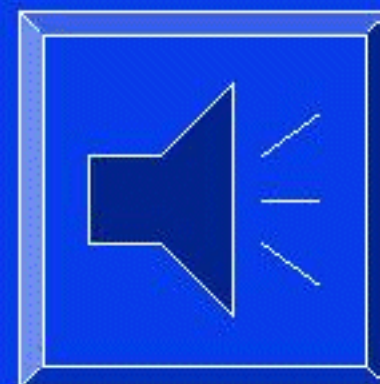


Pre-Repair



Post-Repair

“The ABC’s”

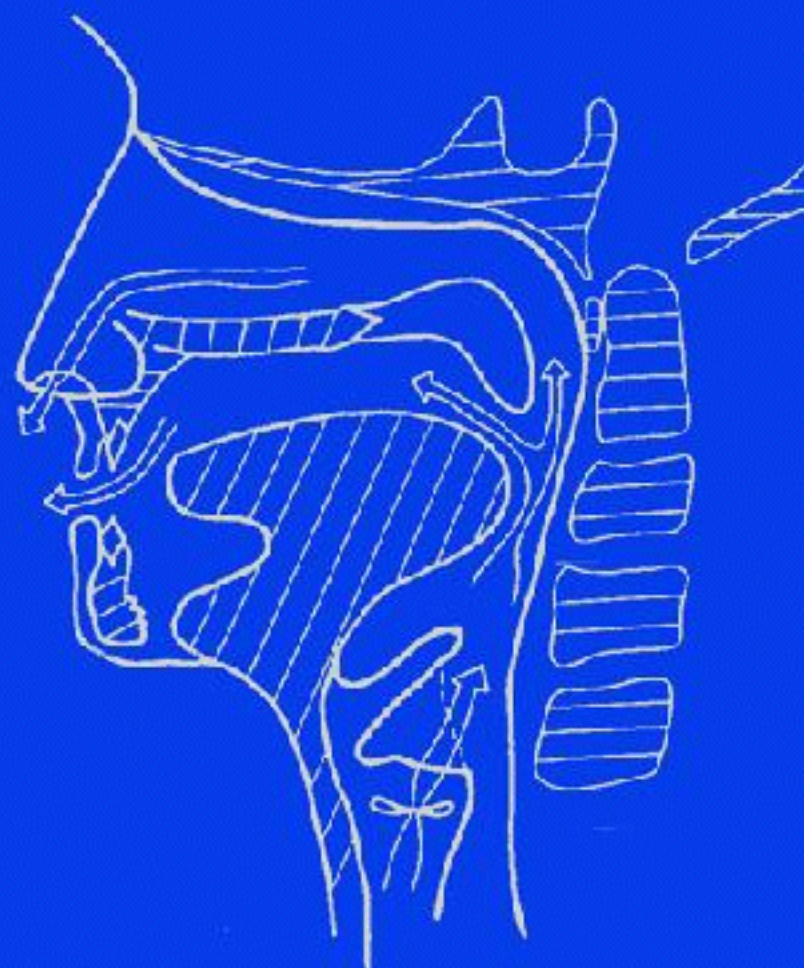




# Valving Mechanism Dysfunctional with Clefts



Normal  
Closure



Inadequate  
Closure



# Methods: Volume Building

